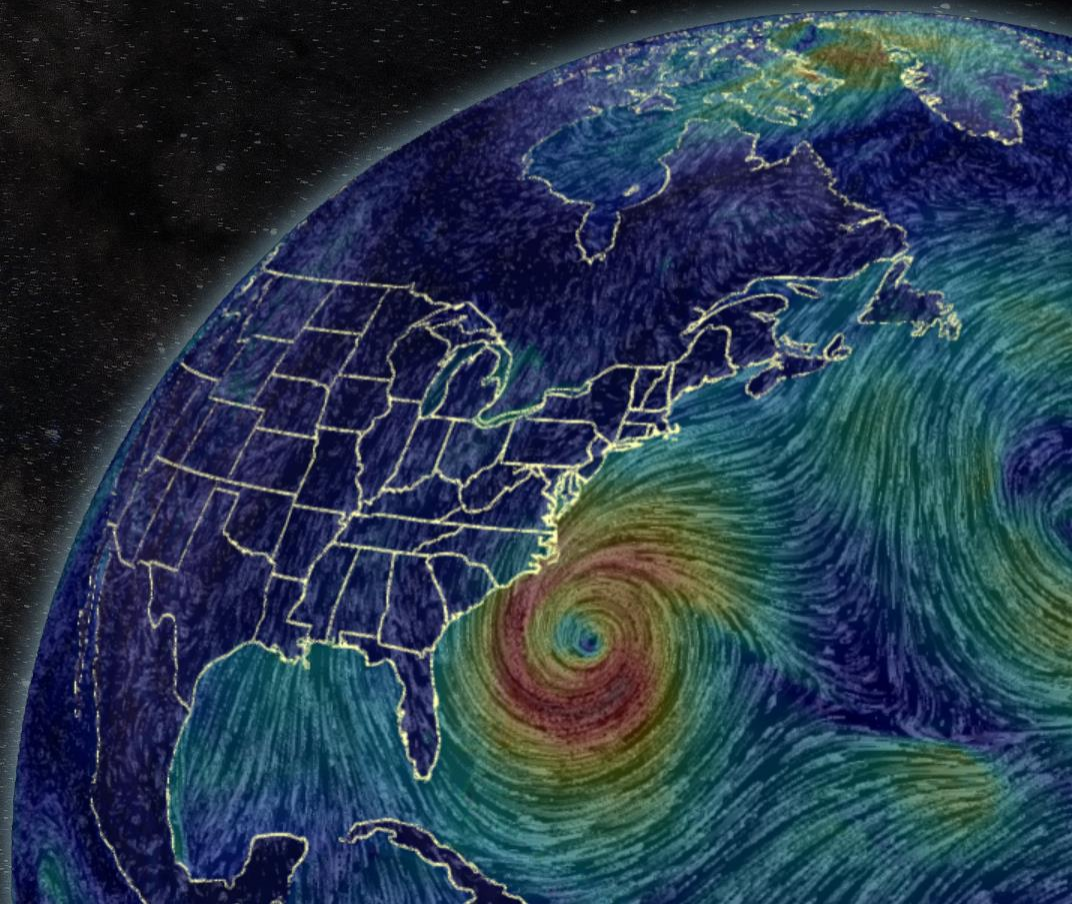
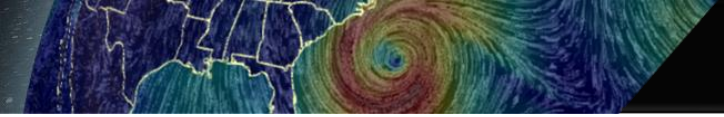
Global Systems Division

Overview

Kevin Kelleher, Director
NOAA/ESRL/GSD

3-5 Nov 2015





Welcome & Thank You!

Outline for the Presentation

GSD Overview

- Who is GSD?
- Workforce
- Budget

Video

Evaluation Criteria

- Quality
  - Awards
  - Service to Professional Societies
  - Publications
  - Tech Transfer
- Relevance
  - To Dept. of Commerce
  - To NOAA
  - To OAR
  - To Commercial Sector
  - To Applications (R2O, R2A, R2X)

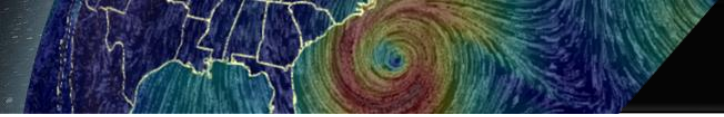
Evaluation Criteria (cont.)

- Performance
  - Strategic Accomplishments
  - Leveraging Collaborations
  - Portfolio Balance
  - Leadership & Innovation
  - Intellectual Property
  - Strategic Agreements & Direction

Path to the Future

Outline for the Next 2 Days

Who is GSD?



Overview

Vision

“Making Forecasts Better!”

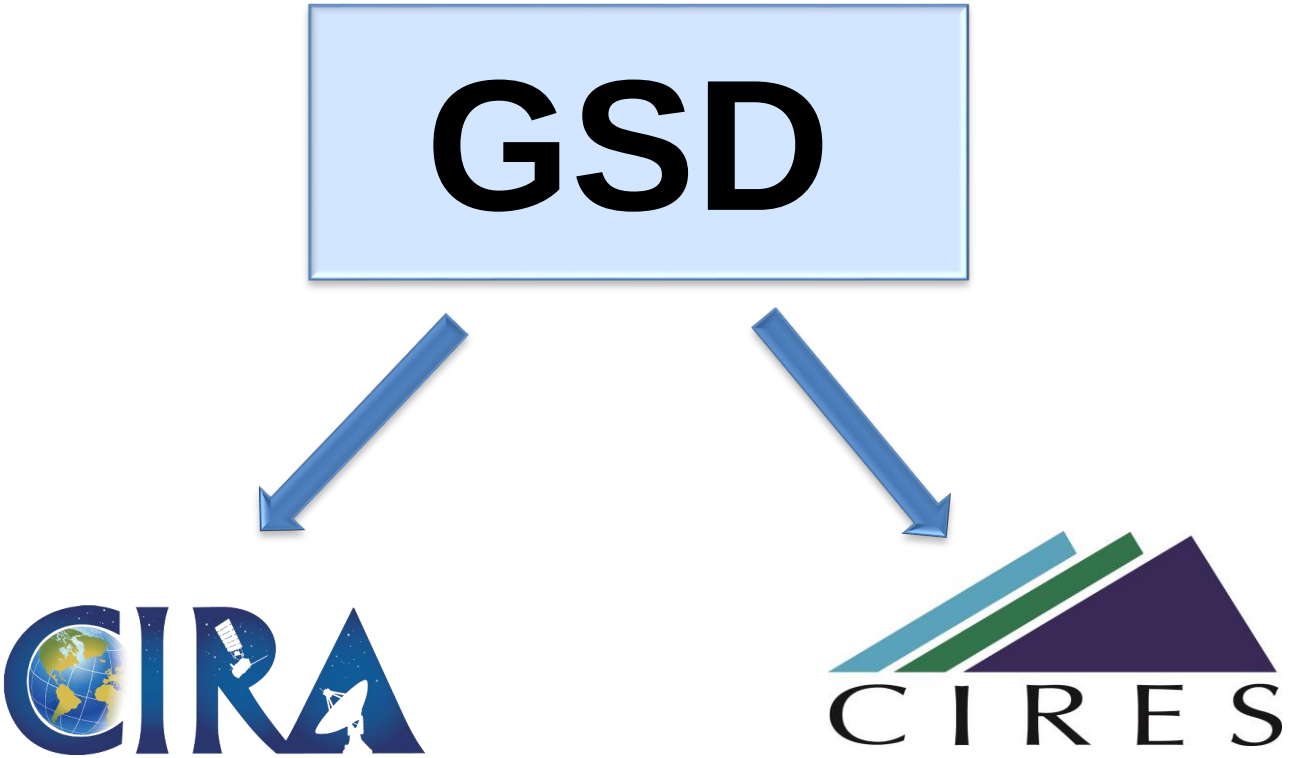
Mission

“GSD is a leader in the *applied research*, *directed development*, and *technology transfer* of environmental data, models, products, and services that enhance environmental understanding with the outcome of supporting commerce, supporting operations in protecting life and property, and promoting a scientifically literate public”

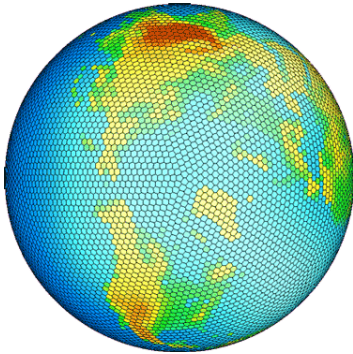
Our Place in the World

- National Weather Service
- National Environmental Satellite Data and Information Service
- **Oceanic & Atmospheric Research**
  - **Earth System Research Laboratory**
    - Physical Sciences Division
    - **Global Systems Division**
    - Global Monitoring Division
    - Chemical Sciences Division
- National Ocean Service
- Office of Marine and Aviation Operations
- National Marine Fisheries Service

Our Scientific Partners



Our Roots



1980
Program for Regional Observing and Forecasting Services (PROFS)

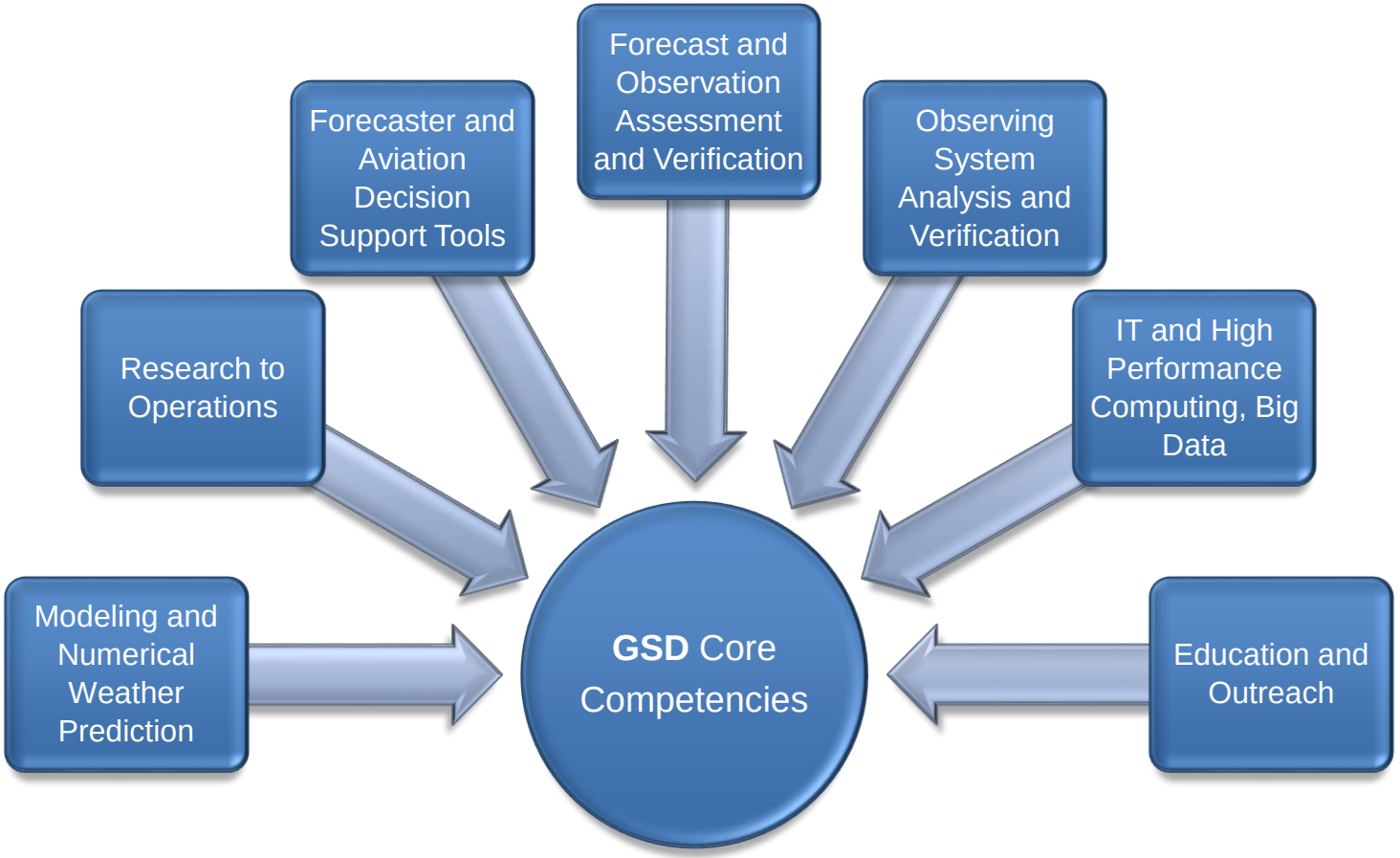
1990
Forecast Systems Laboratory (FSL)

2000

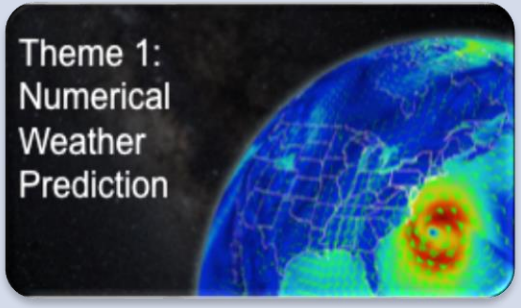
2005
Global Systems Division (GSD)

2015

GSD Core Competencies



Review Themes



Numerical Weather Prediction

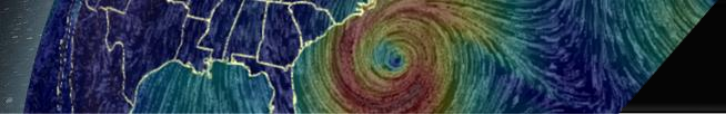
- Regional Models
- Global Models
- Cross-Cutting Activities

Decision Support

- Forecaster Support
- Aviation Support

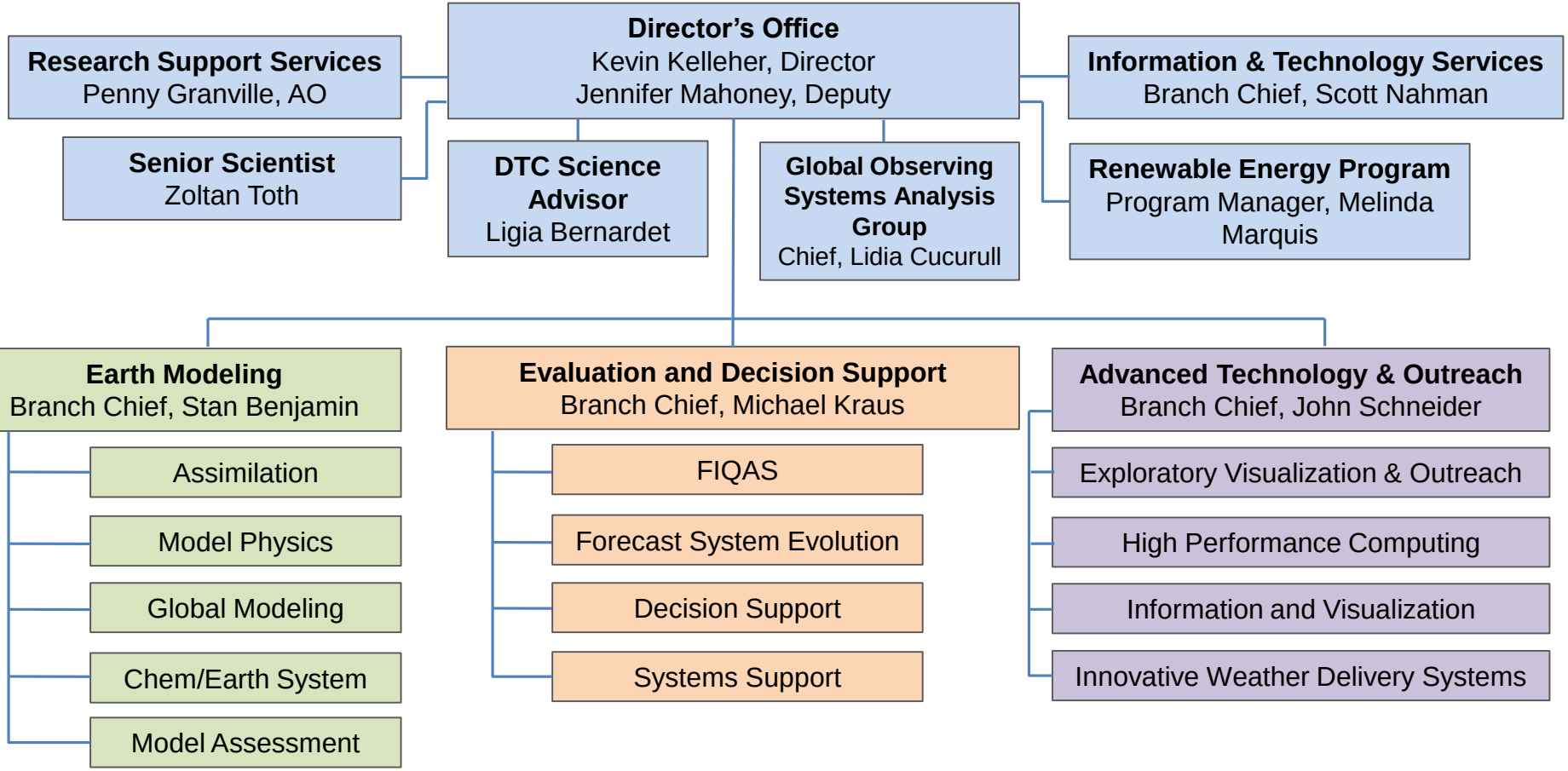
Advanced Technologies

- Advanced Tech
- Outreach and Research to Operations

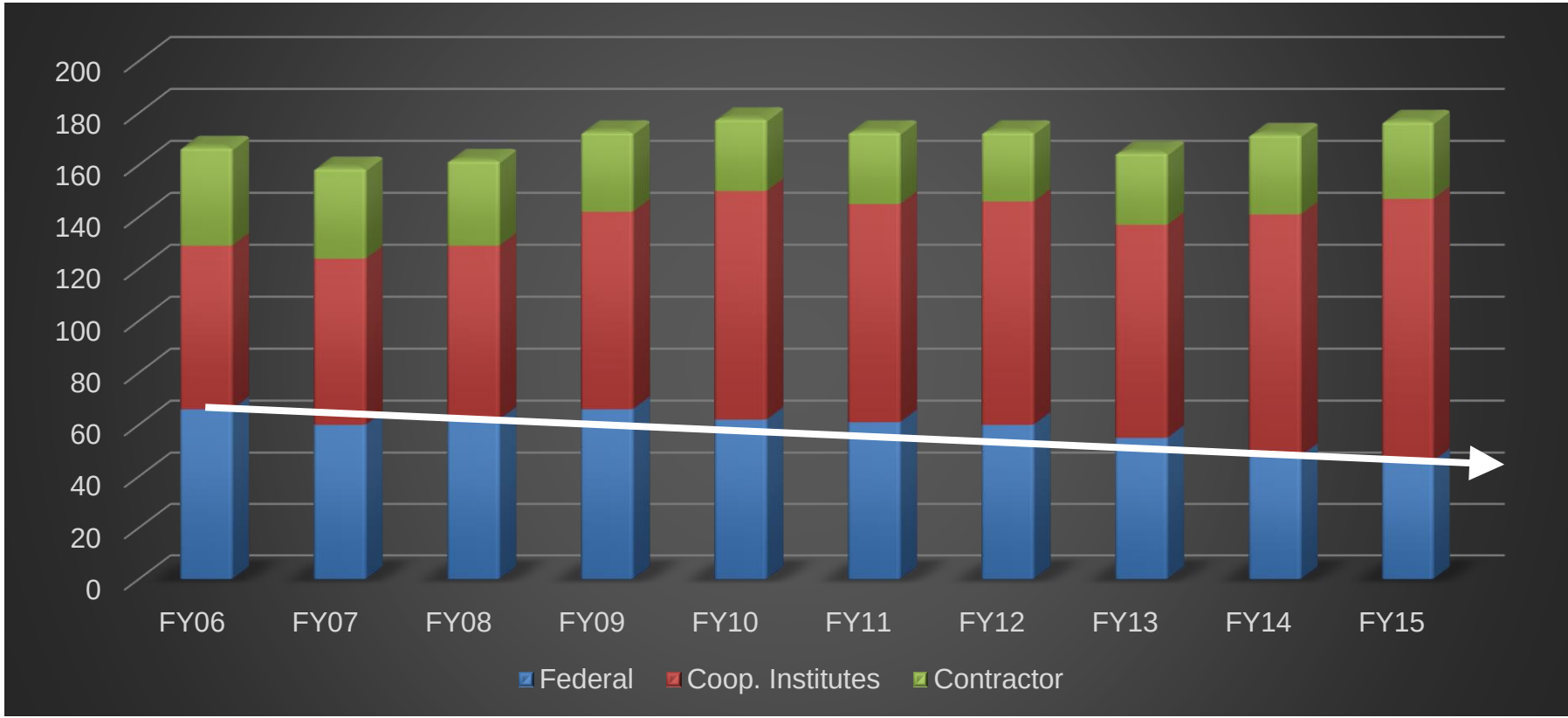


GSD Workforce

GSD Re-Organization (new FY2016)

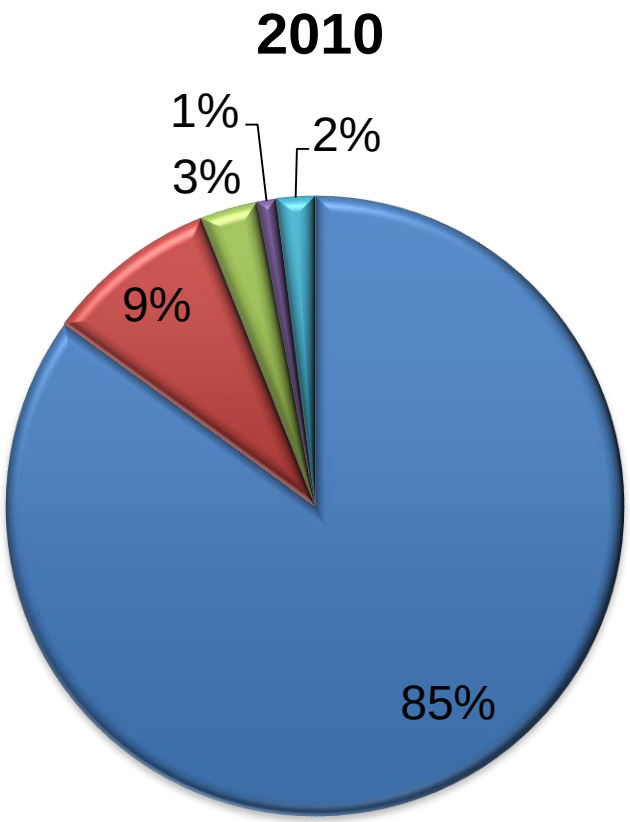


GSD 10-Year Staffing Profile

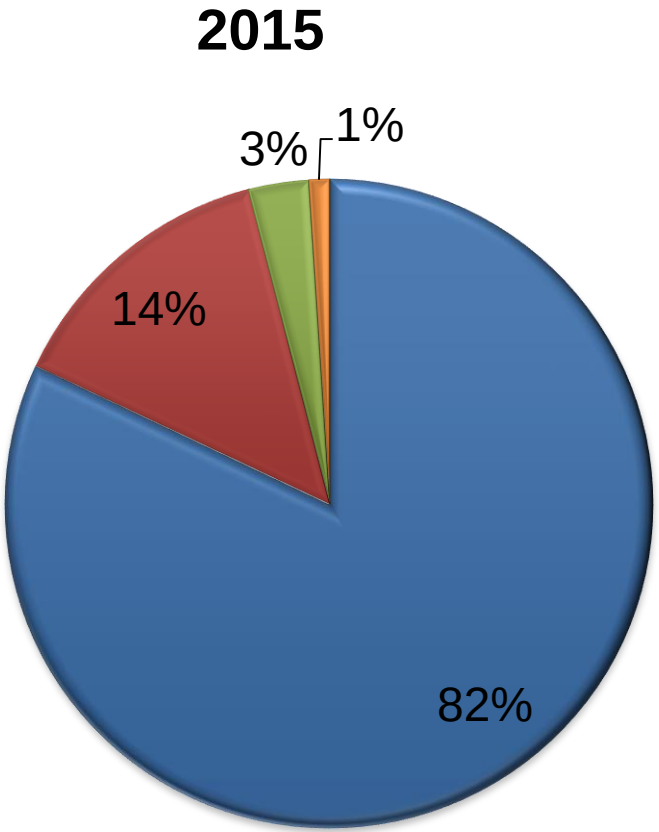


	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15
Total Staff	**167**	**159**	**162**	**173**	**178**	**173**	**173**	**165**	**172**	**177**

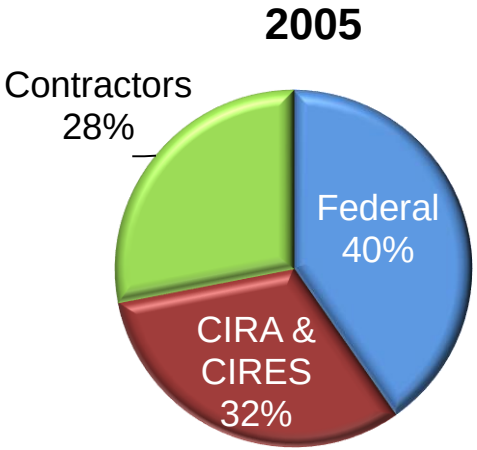
Staff Diversity

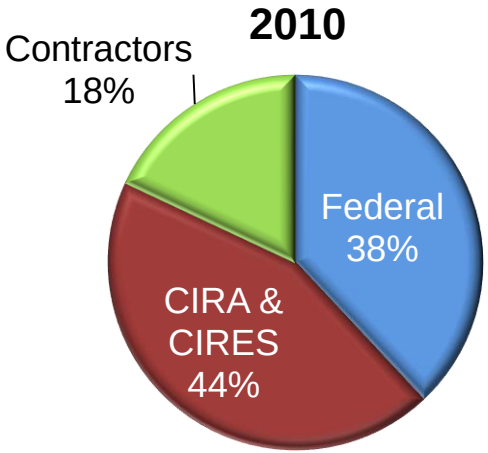


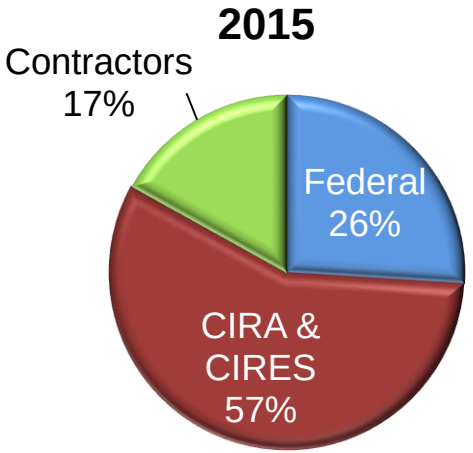
White/Non-Hispanic
East and South Asian
Hispanic
African American
Native American
White/Hispanic

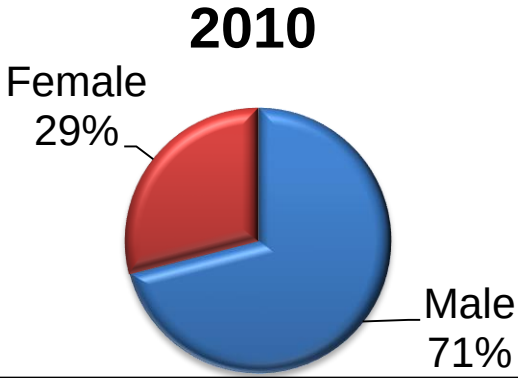


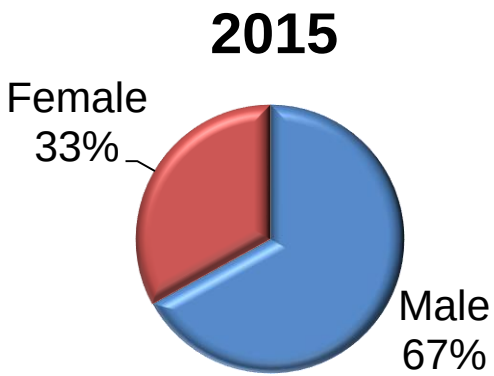
GSD Staff Distribution



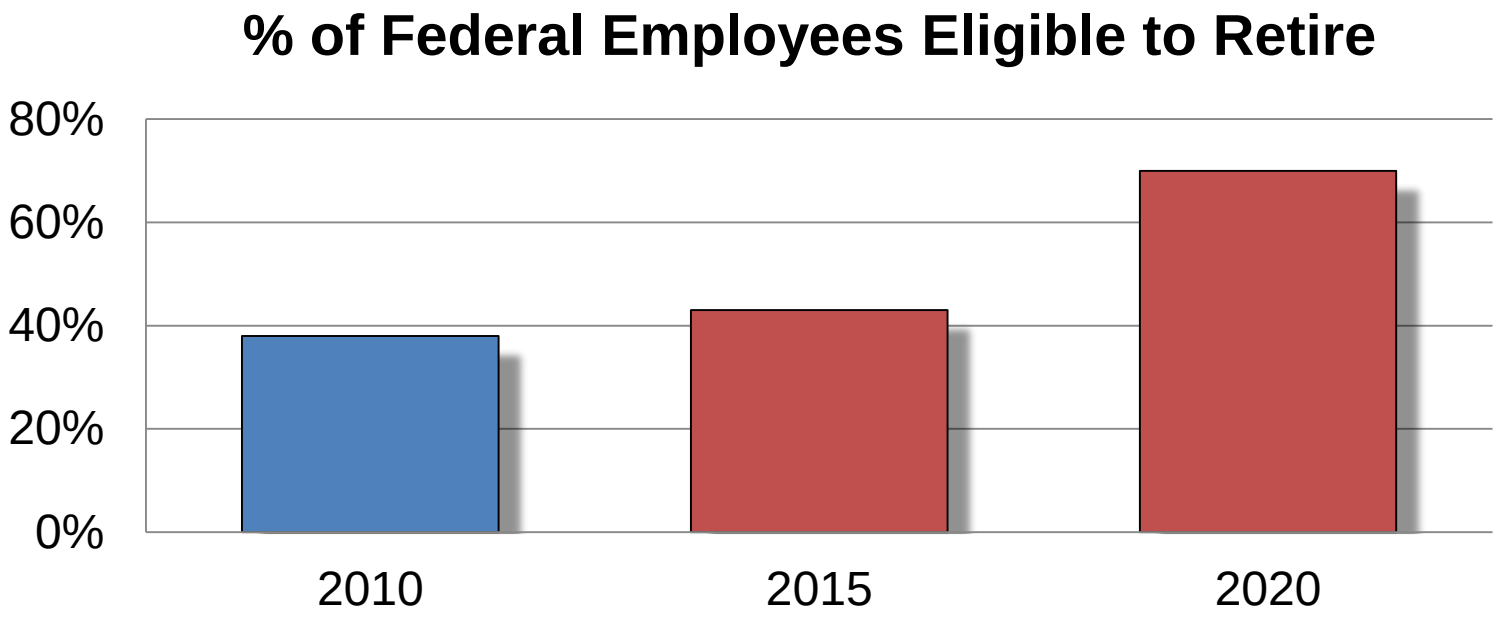








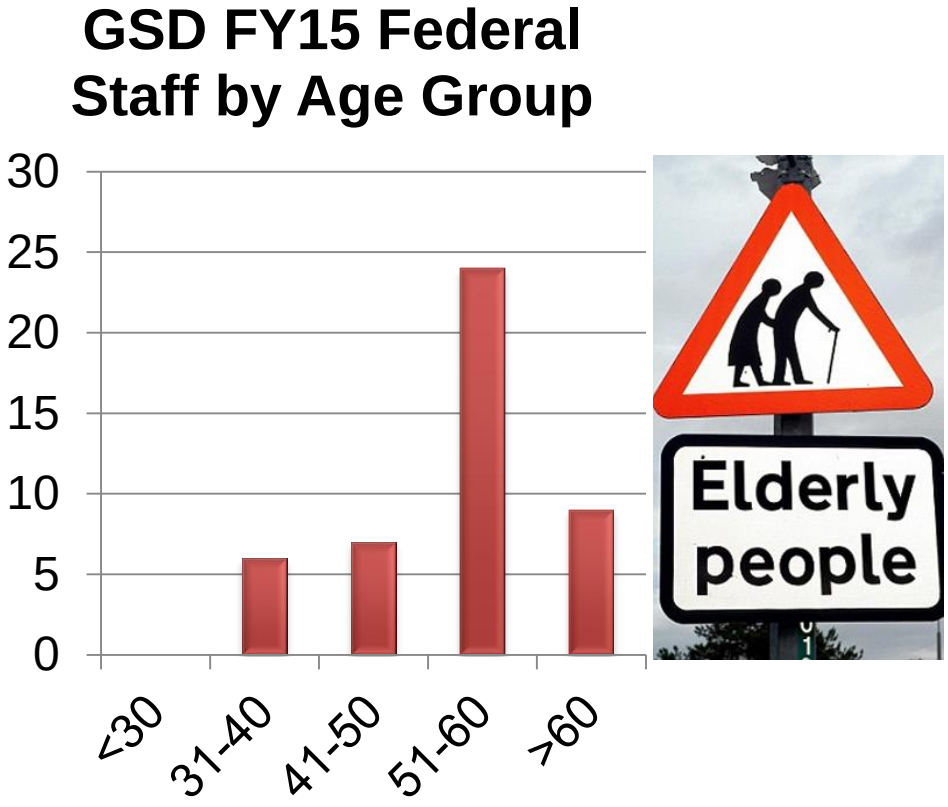
Federal Retirement Eligibility



2015
Average age of Federal Employees = ~60
Eligible to retire = 43%

2020
Average age of Federal Employees = 65
Eligible to retire = >70% (est.)

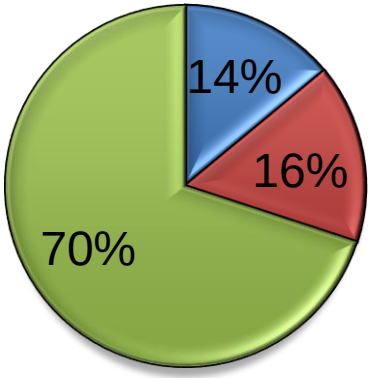
Distribution by Age Group



CIRES & CIRA employees are ~ 15 years younger!

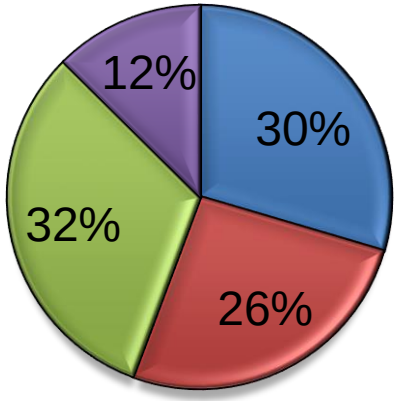
Education

Function



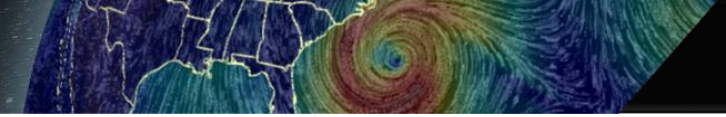
- Management/Admin
- IT Support
- Scientists

Education Level



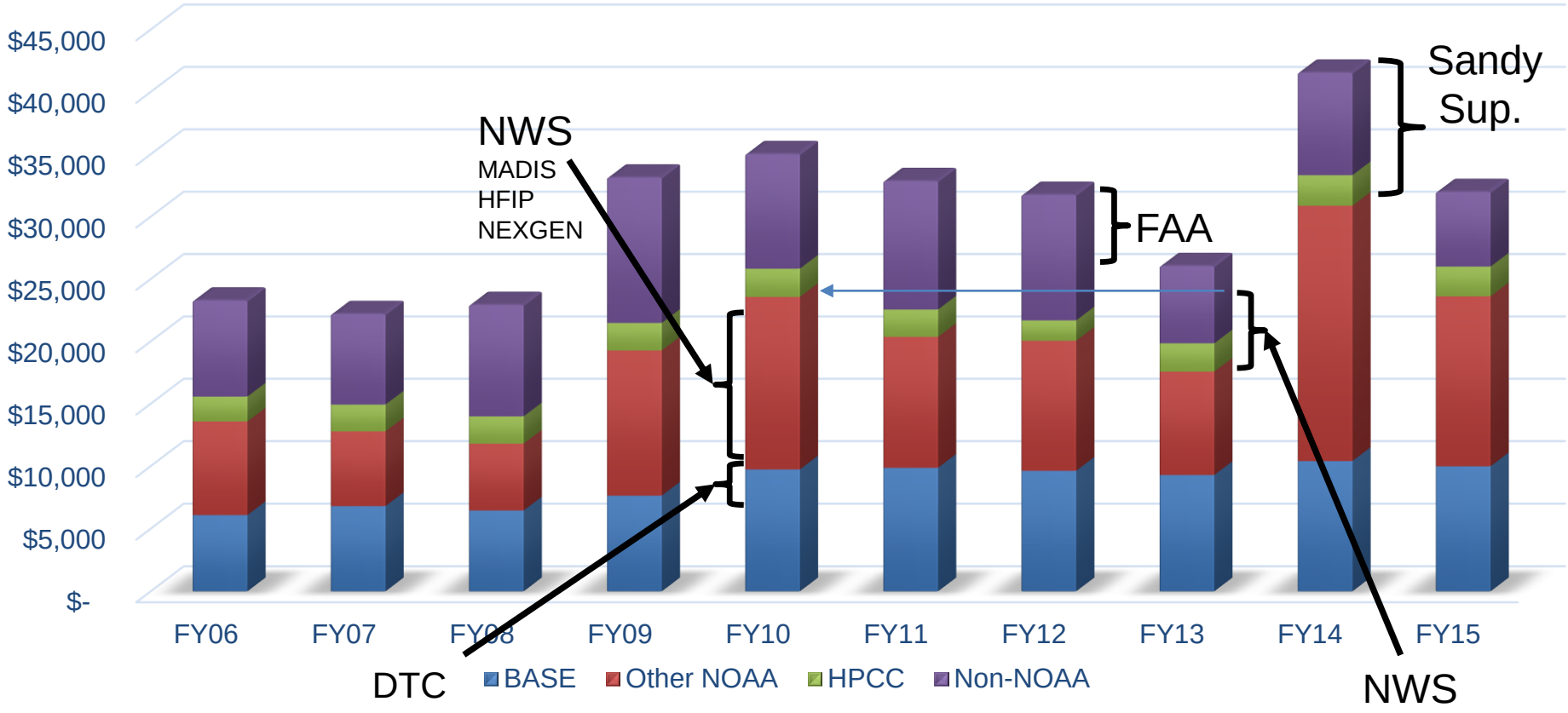
- PhD
- Masters
- Bachelors
- Other

Total GSD Staff and Affiliates: 174
Currently representing OAR, CIRES, CIRA, NWS

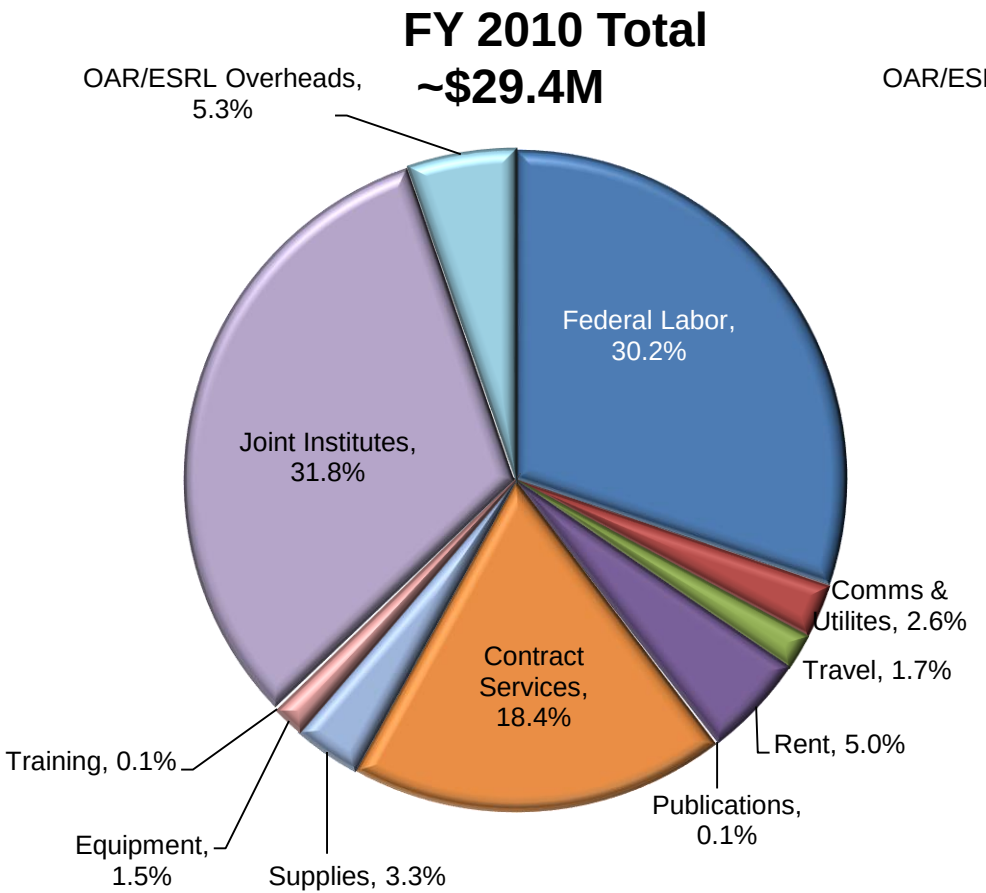


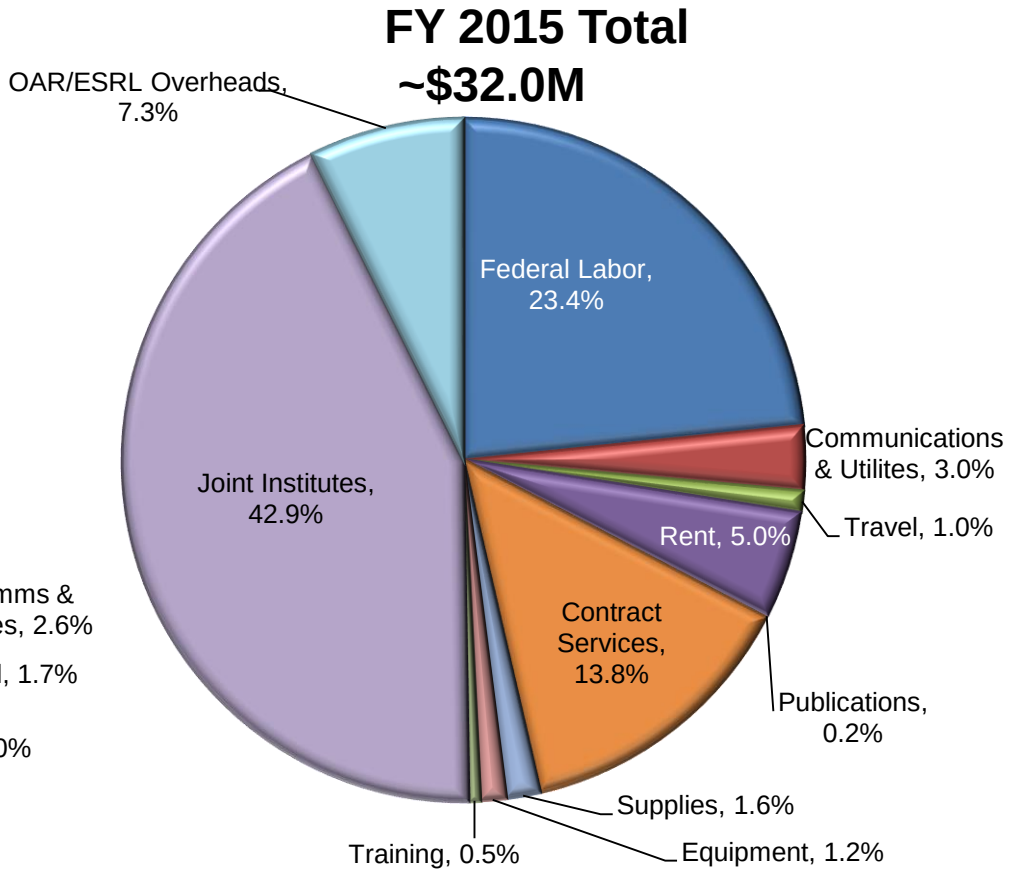
GSD Budget

GSD 10-Year Funding Profile

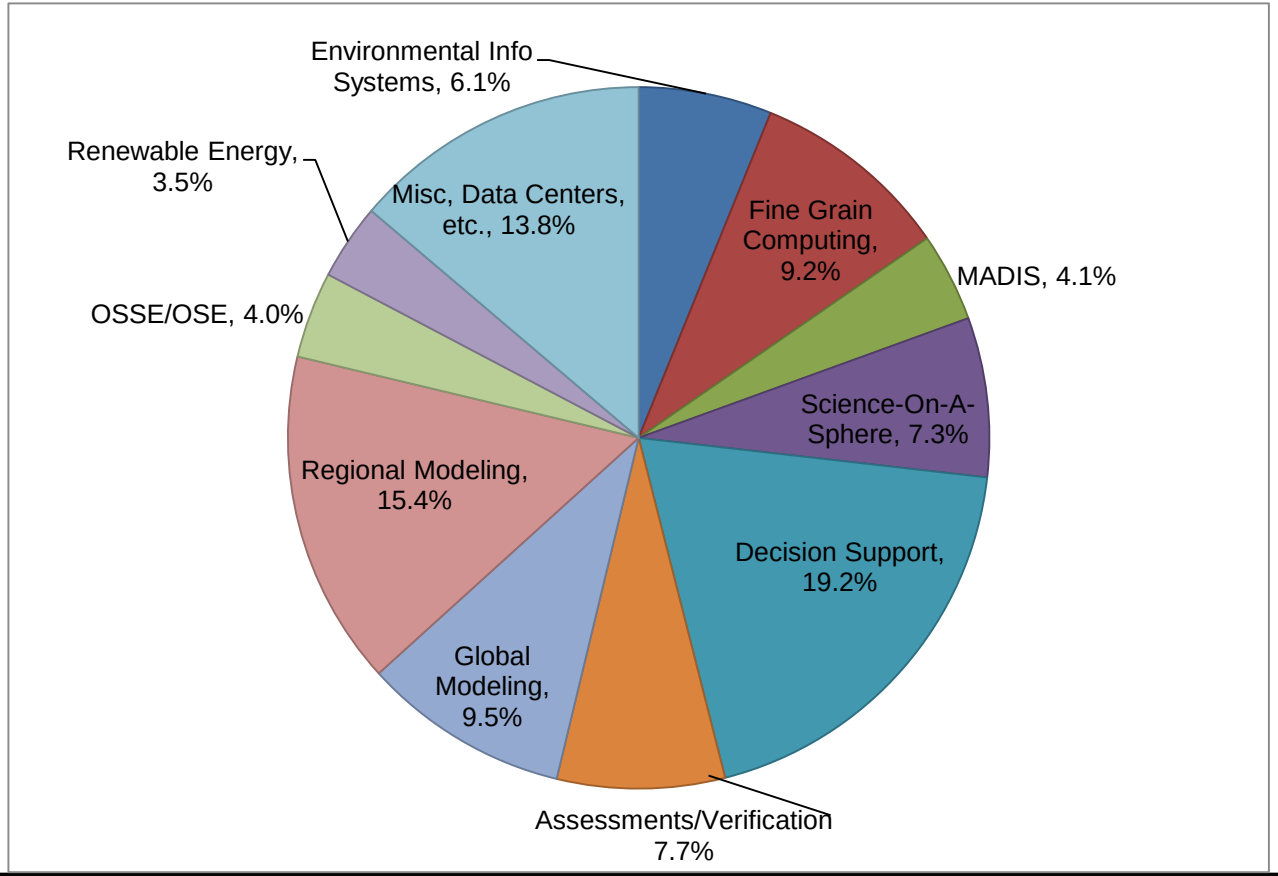


GSD Expenditures





GSD Funding by Project



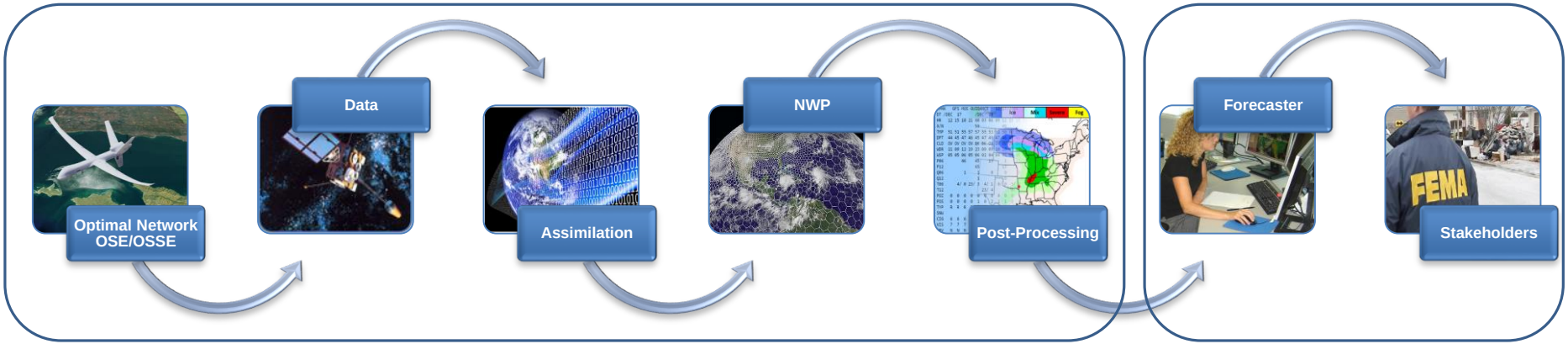
FY 2015 Total ~$32M

Breadth of GSD's Mission

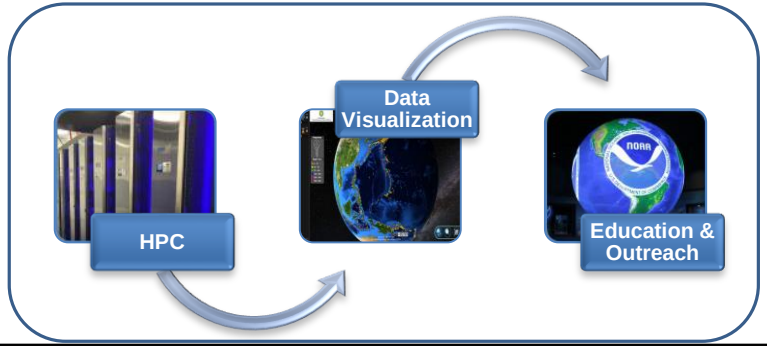
We strive to improve every link in the chain!

Theme 1: NWP

Theme 2: Decision Support

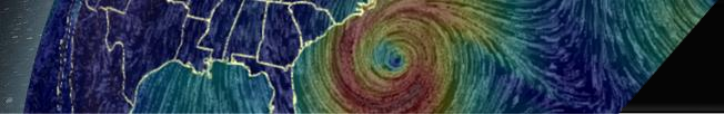


Theme 3: Advanced Technologies



Placeholder slide

Show video…



Evaluation Criteria

Quality

Evaluation Criteria: Quality

"**Quality**" is "a measure of the novelty, soundness, accuracy, and reproducibility of a specific body of research." This refers to the merit of R&D within the scientific community.

Quality: DOC Awards

2015 DoC Gold Medal: **[HRRR]** GSD Modeling Branch w/NWS/EMC for the success of High-Resolution Rapid Refresh, the first storm-scale model to give forecasters and decision-makers fast, local weather guidance

2015 Bronze Medal: [SOS] GSD Staff for achieving the 100th worldwide Science On a Sphere installation and continue to grow its global engagement of the public in NOAA Science

2014 Bronze Medal: [HPC] Joint award for dedication in acquiring supercomputing services to sustain production of the Nation's operational numerical weather and climate forecast systems

2010 Bronze Medal: [Data Assimilation] For developing the first NCEP operational radar reflectivity assimilation technique and improving storm forecasting

2010 Bronze Medal: [GPS-Met] For innovative contributions to the development of the Coastal Atmospheric River Monitoring and Early Warning System

Quality: NOAA Awards

2015 NOAA Administrator's Award
Meteorological Assimilation Data System (MADIS)

2014 NOAA Administrator's Award
NOAA Testbeds and Proving Grounds

2014 Distinguished Career Award
- Darien Davis

2012 NOAA Research Employee of the Year
- David Himes
- Staff of the Assimilation and Modeling Branch

2011 NOAA Administrator's Award
Leadership in Ground-based GPS Observing Network

Quality: Awards

CO-LABS
Promote. Educate. Connect.

2015 Governor's Award for High-Impact Research

HRRR Model (High-Resolution Rapid Refresh)

AMS Editors Award (2015)

AMS Outstanding Leadership Award (2015)

CIRA Research & Service Initiative Award (2010, 2013, 2015)

CIRES Outstanding Performance Award (2011, 2013, 2014, 2015)

CIRES Bronze Medals (2010, 2015)

Quality: Service to Professional Societies

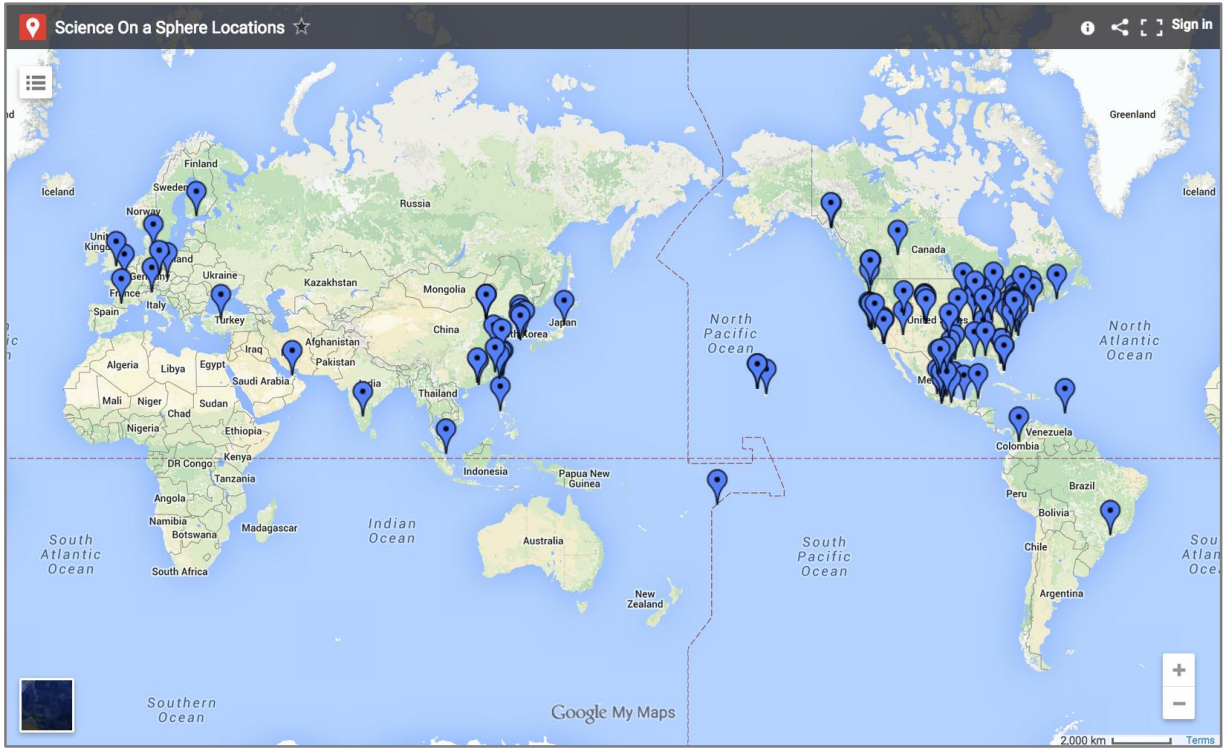
- American Meteorological Society Fellows (4)
- Chief, Co-Chief, and Assoc. Editors (9)
- Conference/Program Chairs (3)
- Committee Chair (8)
- Session Chairs (numerous)

Quality: Service in Education

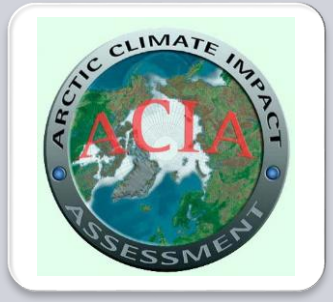
- Adjunct, affiliate, or emeritus faculty (14)
- Undergrads mentored, M.S. and Ph.D. Committees (12)

Science On a Sphere®

70 teachers trained in SOS accredited classes
128 installations
33 million viewers/year
12 distributors
500 free datasets



Quality: International Service



World Meteorological Organization Commission for Instruments and Methods of Observation

- Remote Sensing
- Aircraft Display Panel
- Science Advisory Group

The Observing Research and Predictability Experiment (THORPEX)

- International Core Steering Committee
- Global Interactive Forecasting System Ensemble

International Panel on Climate Change

- Editor of Assessment Reports

European Geophysical Union

- Secretary for Predictability Section in Nonlinear Processes in the Geosciences Division

Arctic Climate Impact Assessment

- Lead author Arctic Climate Impact Assessment

Quality: International Service

Lidia Cucurull, Chair, Expert Team on New-Remote Sensing Technology

Zoltan Toth, THORPEX U.S. Representative, International Core Steering Committee
(The Observing system Research and Predictability Experiment)

World Meteorological Organization Commission Instruments Methods Observation
- Remote Sensing
- Aircraft Display Panel
- Science Advisory Group

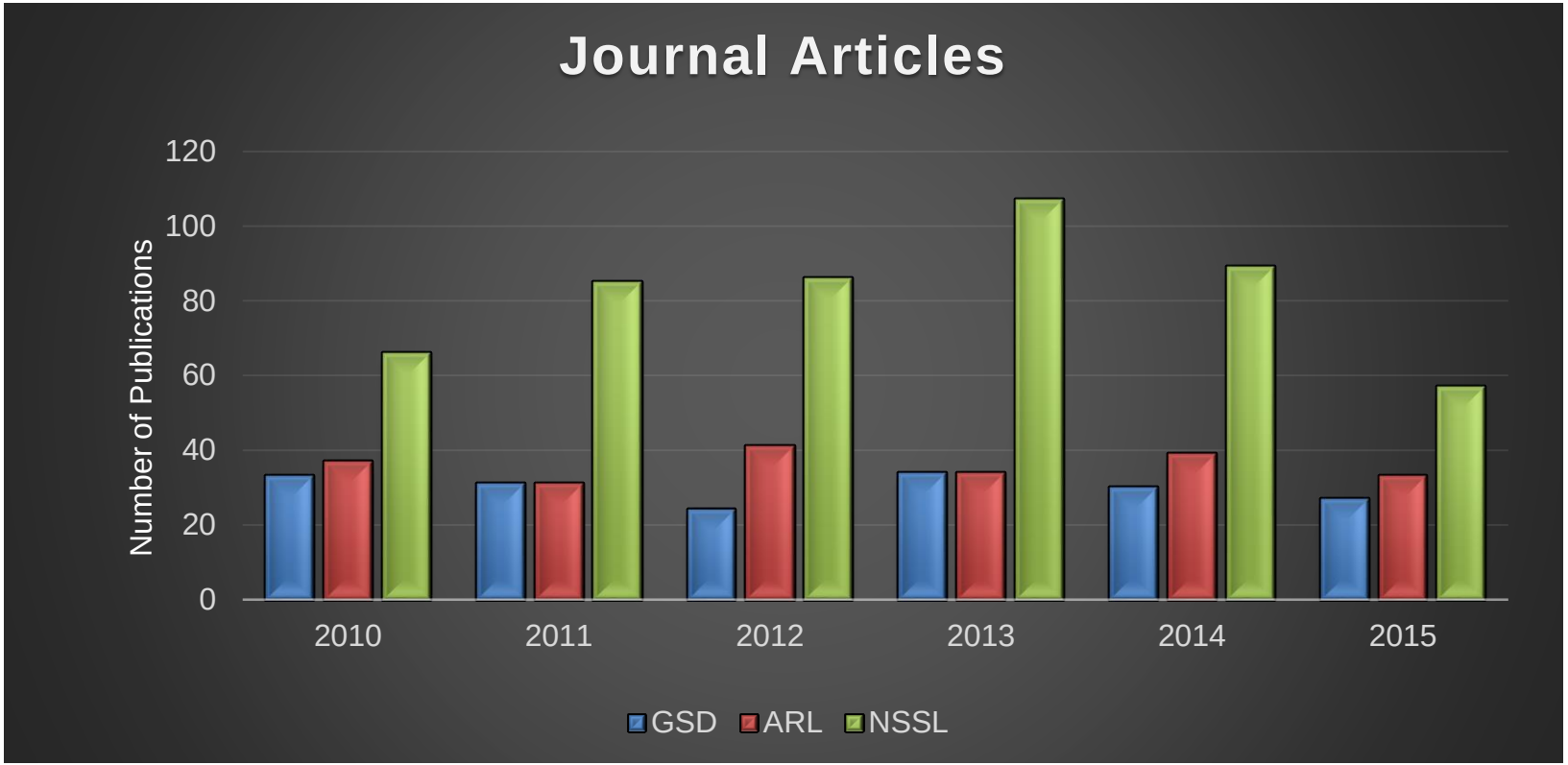
The Observing Research and Predictability Experiment (THORPEX)
- International Core Steering Committee
- Global Interactive Forecasting System Ensemble

International Panel on Climate Change
- Editor of Assessment Reports

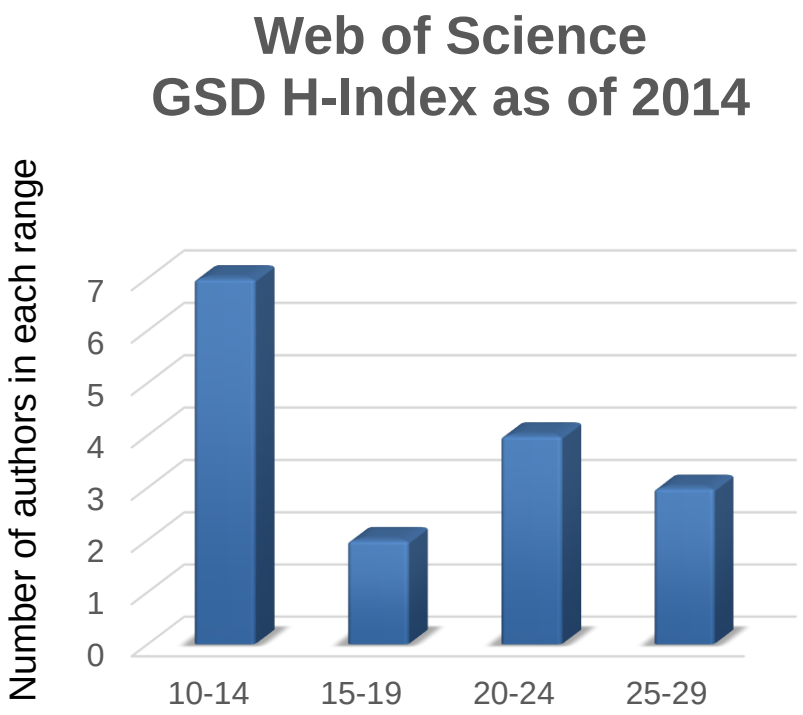
Nonlinear Processes in the Geosciences Division

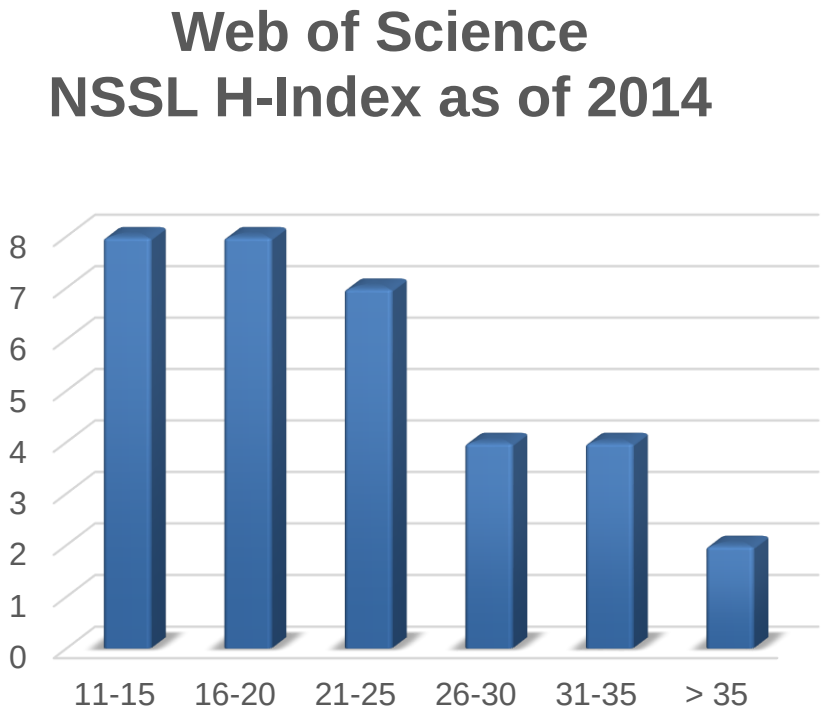
Assessment

Quality: Publications

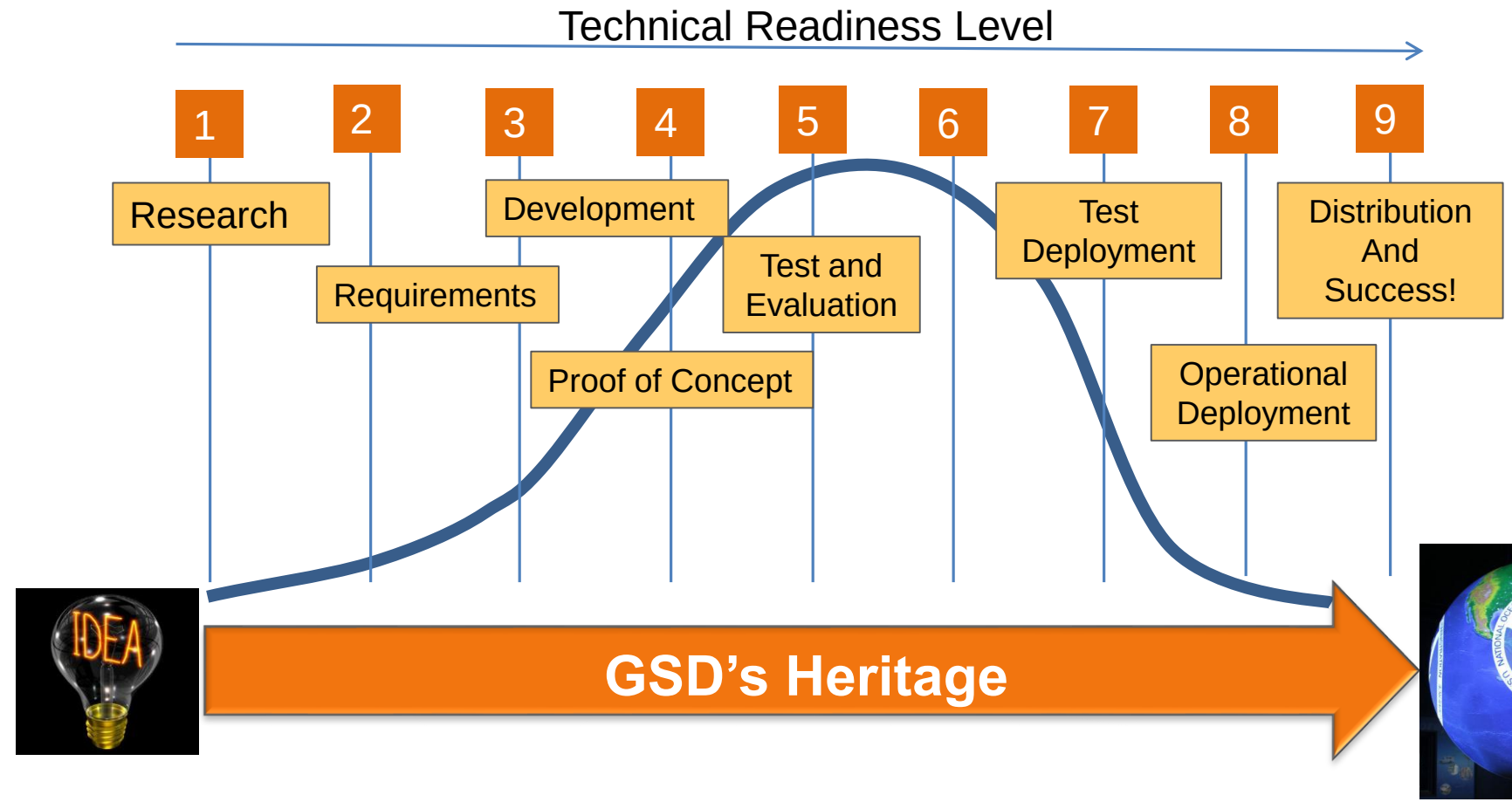


Quality: Publications





Quality: Focus on Tech Transfer



Relevance

Evaluation Criteria: Relevance

"**Relevance**" is "a measure of how well a specific body of research supports NOAA's mission and the needs of users and the broader society." Primarily refers to value of R&D to users beyond the scientific community. Includes not only hypothetical value, but actual impact.

Relevance: DOC FY14-18 DOC Goals

DOC Goal 1: Trade and Investment Increase opportunities for U.S. companies by opening markets globally	•Science on a Sphere (SOS) •Taiwan (Central Weather Bureau collaboration)
DOC Goal 3: Environment Advance the understanding and prediction of changes in the environment	•High-Impact Weather Improvement Project (HIWPP) •Next-Generation Global Prediction Modeling (NGGPS) •Developmental Testbed Center (DTC)
DOC Goal 3: Environment Build a Weather Ready Nation	•High Resolution Regional Models (HRRR) •Decision Support Systems (INSITE) •FACETs (end-to-end Warning)
DOC Goal 3: Environment Enable U.S. businesses to adapt and prosper by developing environmental and climate informed solutions	•Aviation weather forecasting •TerraViz/NEIS •Renewable Energy
DOC Goal 4: Data Position the Department of Commerce to meet society's future data needs	•Massively Parallel Fine Grain (MPFG) computing •OSSEs/OSEs
DOC Goal 5: Operational Excellence Improve facilities, support services, and IT products and services to drive mission success	•AWIPS-2 •FACETs

Relevance: DOC FY14-18 DOC Goals

DOC Goal 1: Trade and Investment
Increase opportunities for U.S. companies by opening markets globally

- Science on a Sphere (SOS)
- Taiwan (Central Weather Bureau collaboration)

DOC Goal 3: Environment
Advance the understanding and prediction of changes in the environment

- High-Impact Weather Improvement Project (HIWPP)
- Next-Generation Global Prediction Modeling (NGGPS)
- Developmental Testbed Center (DTC)

DOC Goal 3: Environment
Build a Weather Ready Nation

- High Resolution Regional Models (HRRR)
- Decision Support Systems (INSITE)
- FACETs (end-to-end Warning)

DOC Goal 3: Environment
Enable U.S. businesses to adapt a
developing environmental and climate i

forecasting

DOC Goal 4: Data
Position the Department of Commerce
future data needs

DOC Goal 5: Operational Ex
Improve facilities, support services, an
services to drive mission su

"Build a Weather Ready Nation"
Regional Models – HRRR; improving high impact weather forecasts
Decision Support Systems – INSITE; improving aviation safety
FACETs – Improving the end-to-end Warning process

Relevance: NOAA's Strategic Plan

1= primary partner, 2 = contributing partner, 3 = proposed future partner.

GOAL	OBJECTIVE	GSD
CLIMATE ADAPTATION AND MITIGATION	Assessments Of Current And Future States Of The Climate System That Identify Potential Impacts And Inform Science, Service, And Stewardship Decisions	3
	A Climate-literate Public That Understands Its Vulnerabilities To A Changing Climate And Makes Informed Decisions	1
WEATHER-READY NATION	Reduced Loss Of Life And Disruption From High-impact Events	1
	Improved Transportation Efficiency And Safety	1
	Healthy People And Communities By Improving Air And Water Quality Services	2
	A More Productive And Efficient Economy Through Environmental Information Relevant To Key Sectors Of The U.S. Economy	1
SCIENCE & TECHNOLOGY ENTERPRISE	A Holistic Understanding Of The Earth System Through Research	1
	Accurate And Reliable Data From Sustained And Integrated Earth Observing Systems	1
	An Integrated Environmental Modeling System	1
ENGAGEMENT ENTERPRISE	An Engaged And Educated Public With An Improved Capacity To Make Scientifically Informed Environmental Decisions	1
	Integrated Services Meeting The Evolving Demands Of Regional Stakeholders	2
	Full And Effective Use Of International Partnerships And Policy Leadership To Achieve NOAA's Mission Objectives	2
ORGANIZATION & ADMINISTRATION ENTERPRISE	Diverse And Constantly Evolving Capabilities In NOAA's Workforce	2
	A Modern IT Infrastructure For A Scientific Enterprise	2

Relevance: NOAA's Strategic Plan

1= prim

GOAL		
CLIMATE ADAPTATION AN MITIGATION		
WEATHER-READY NATION	Healthy People And Communities By Improving Air And Water Quality Services	2
	A More Productive And Efficient Economy Through Environmental Information Relevant To Key … U.S. Economy	1
SCIENCE & TECHNOLOGY ENTERPRISE	A Holistic U… …th System Through Research	1
ENGAGEMENT ENTERPRISE		
ORGANIZATION & ADMINISTRATION ENTERPRISE	A Modern IT Infrastructure For A Scientific Enterprise	2

Reduced Loss Of Life And Disruption From High-impact Events

** **GSD is a primary partner** – e.g., Regional Modeling / HRRR / RAP)

Healthy People And Communities By Improving Air And Water Quality Services

** **GSD is a contributing partner** – e.g., Atmospheric Chemistry modeling w/Air Resources Lab

Relevance to OAR Strategic Plan

OAR Strategic Plan Element

- Research
  - Observations & Data
  - Models and Experiments
  - Studies and Assessments
- Development
  - Predictions and Projections
  - Emerging Technologies
- Transitions
  - Extension and Outreach
  - Technology Transfer

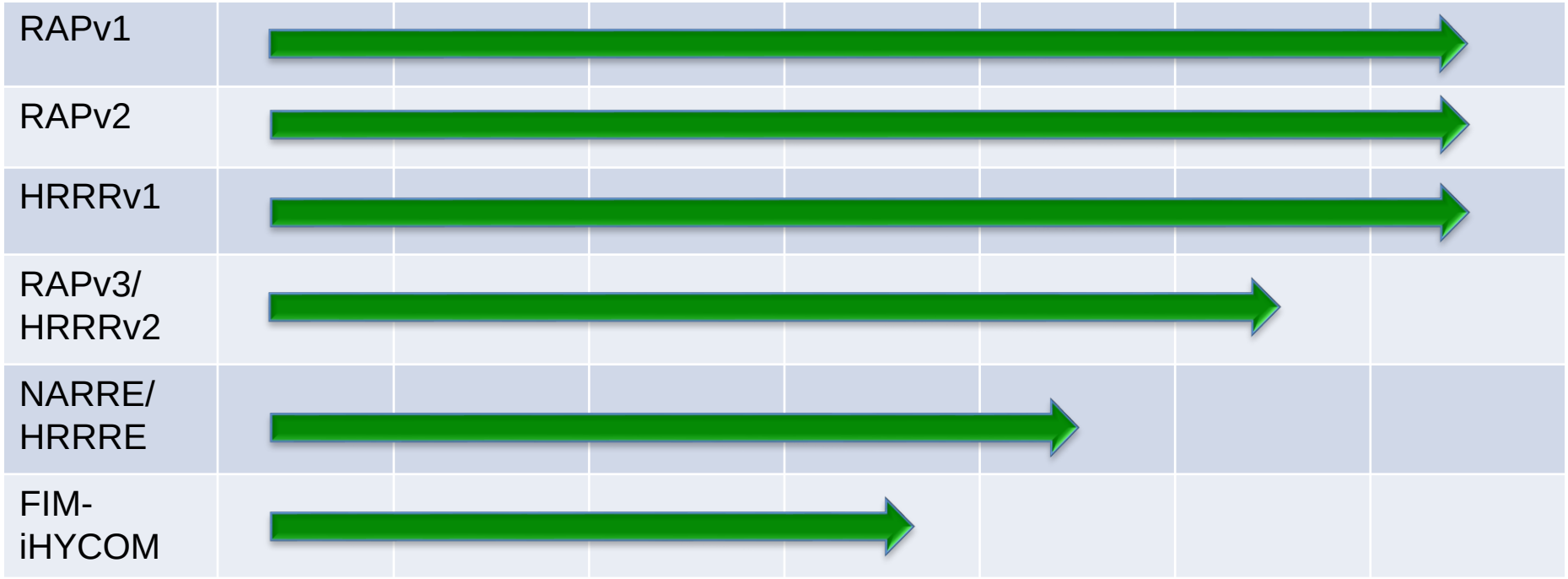
Relevant GSD Activities

- Research
  - OSE/OSSE, MADIS, GPS
  - Regional/Global models
  - Assessments (e.g., MRMS)
- Development
  - Regional/Global models
  - NEIS, MPFG computing
- Transitions
  - SOS
  - HRRR, RAP, MADIS, GPS-RO

Relevance: Research to Applications

Project	TRL 1 Basic Science	TRL 2 Concept formulated	TRL 3-4 Experiment /Validate	TRL 5-6 Prototype Developed	TRL 7 Demo in Testbed	TRL 8 Implement	TRL 9 Transition/ Deploy

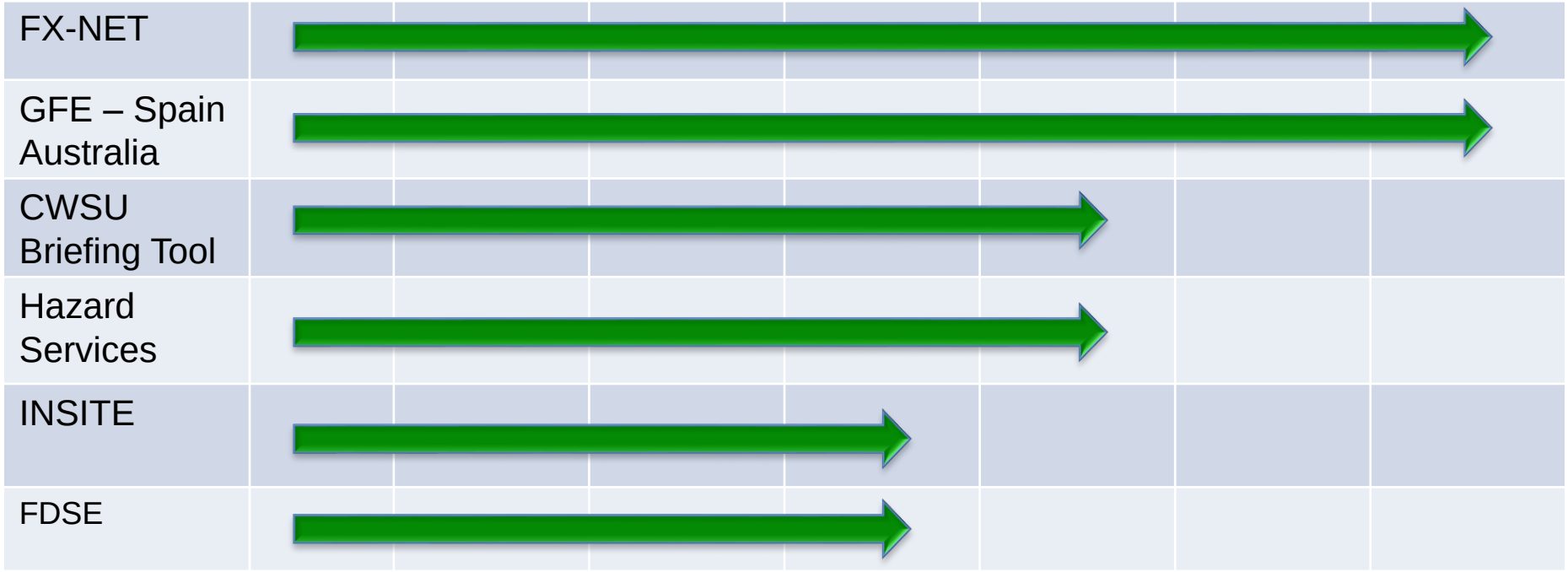
Numerical Weather Prediction 2010-2015



Relevance: Research to Applications

Project	TRL 1 Basic Science	TRL 2 Concept formulated	TRL 3-4 Experiment /Validate	TRL 5-6 Prototype Developed	TRL 7 Demo in Testbed	TRL 8 Implement	TRL 9 Transition/ Deploy

Decision Support 2010-15



Relevance: Research to Applications

Project	TRL 1 Basic Science	TRL 2 Concept formulated	TRL 3-4 Experiment /Validate	TRL 5-6 Prototype Developed	TRL 7 Demo in Testbed	TRL 8 Implement	TRL 9 Transition/ Deploy
Advanced Technologies and Outreach 2010-15							
Science On a Sphere							
MADIS							
GPS-Met /RO							
SOS Explorer							
NEIS and TerraViz							
Fortran to CUDA Compiler							

Relevance: Commercial / Private Sector

Trademarks

Planet Theater

Patents

- Science on a Sphere
- Atmospheric Sondes and Method for Tracking

Patent Pending

- NEIS
- TerraViz

Relevance: Commercial / Private Sector

CRADAs (Cooperative Research And Development Agreements)

AURAIA (air chemistry/quality), ENI/Trimble (GPS-Met), IMSG (aviation)

Non-disclosure Agreements

- Iberdola Renewables
- XCEL Energy
- GIE EUMETNET (Network of European National Meteorological Service
- Federal Aviation Administration

Memorandums of Understanding (MOUs)/Interagency Agreements

- 155

Performance

Evaluation Criteria: Performance

"**Performance**" is "a measure of both effectiveness (the ability to achieve useful results) and efficiency (the ability to achieve quality, relevance, and effectiveness in timely fashion and with little waste)." It refers to the effectiveness and efficiency with which R&D activities are organized, directed, funded, and executed.

Performance: Strategic

Organization

October 1, 2014 - GSD reorganized to reduce redundancy and confusion between Branches

Financial

- October 1, 2015 - $3.3M in recurring fixed costs were cut to reduce the internal overhead (IRA) charged to “customers”
- Reductions avoided an IRA of 42% in FY16 vs. 29%

Strategic Alliances

- NCAR - Signed 5 year MOU to collaborate on NWP and related topics
  - Similar MOU is planned for GFDL, AOML
- SOS – Multiple distributorships across the World
- GOSA Group is fully coordinated with NOAA’s QOSAP (Quantitative Observing System Assessment Program)

Performance: Strategic (cont.)

Strategic Direction

- GSD has identified 5 Grand Challenges for next 5-20 years
- GSD draft Strategic Plan ready for comment
- 60% of NIM modeling resources redirected to assist in NOAA's NGGPS effort

Organizational Excellence

- Executive Coach working with GSD's Senior Leadership Team

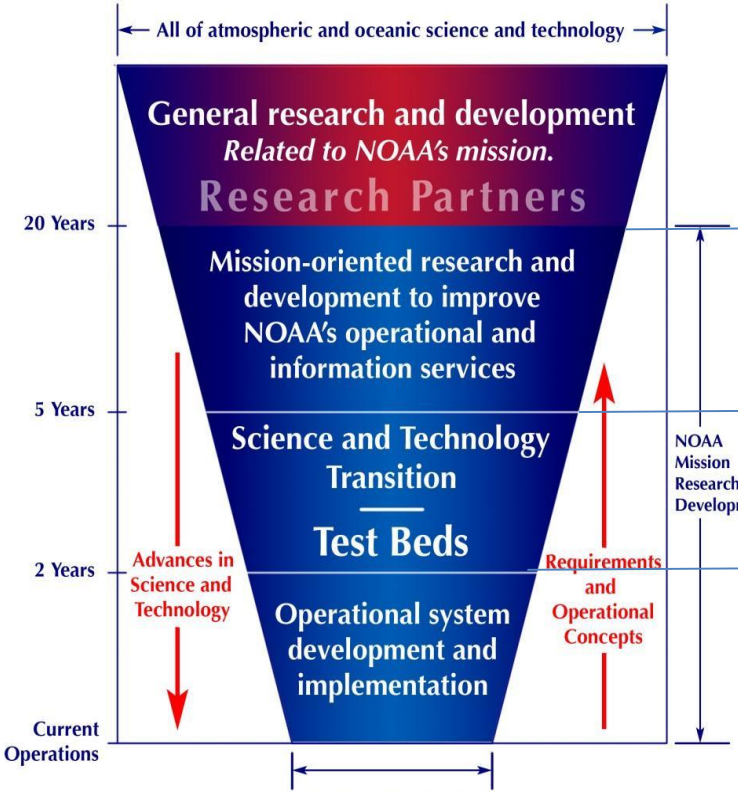
Succession Planning

- Ongoing GSD-wide Mid-Career Training
- Multiple sessions throughout FY15 with Executive Coach
- Several employees attended year-long Colorado Leadership Development

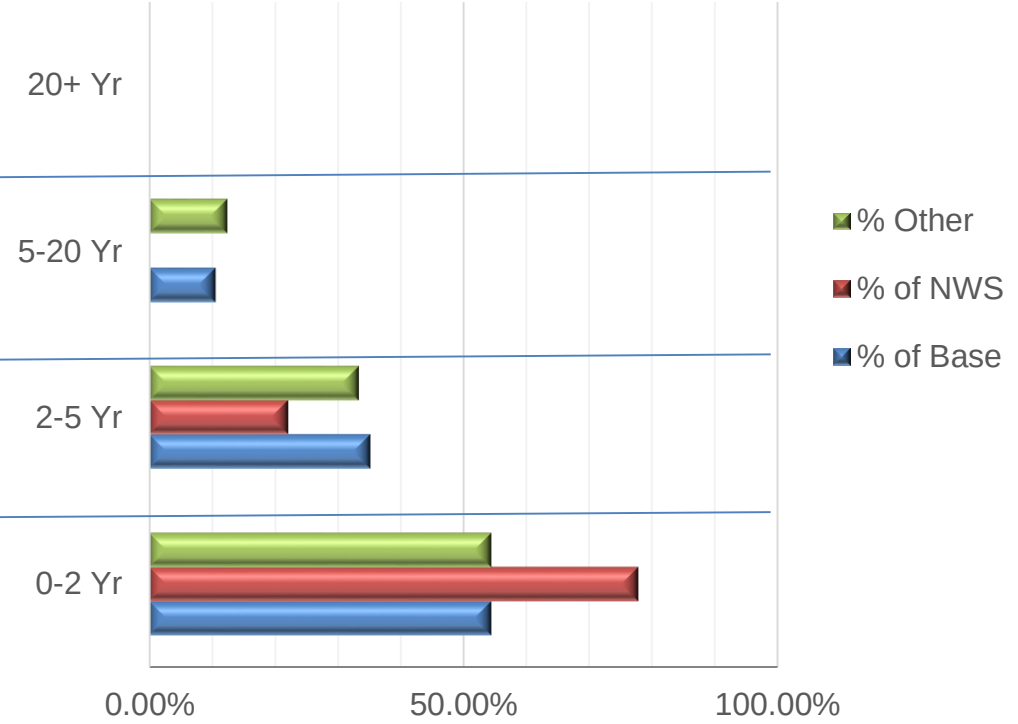
Performance: Leveraging Collaborations

Performance: Portfolio Balance

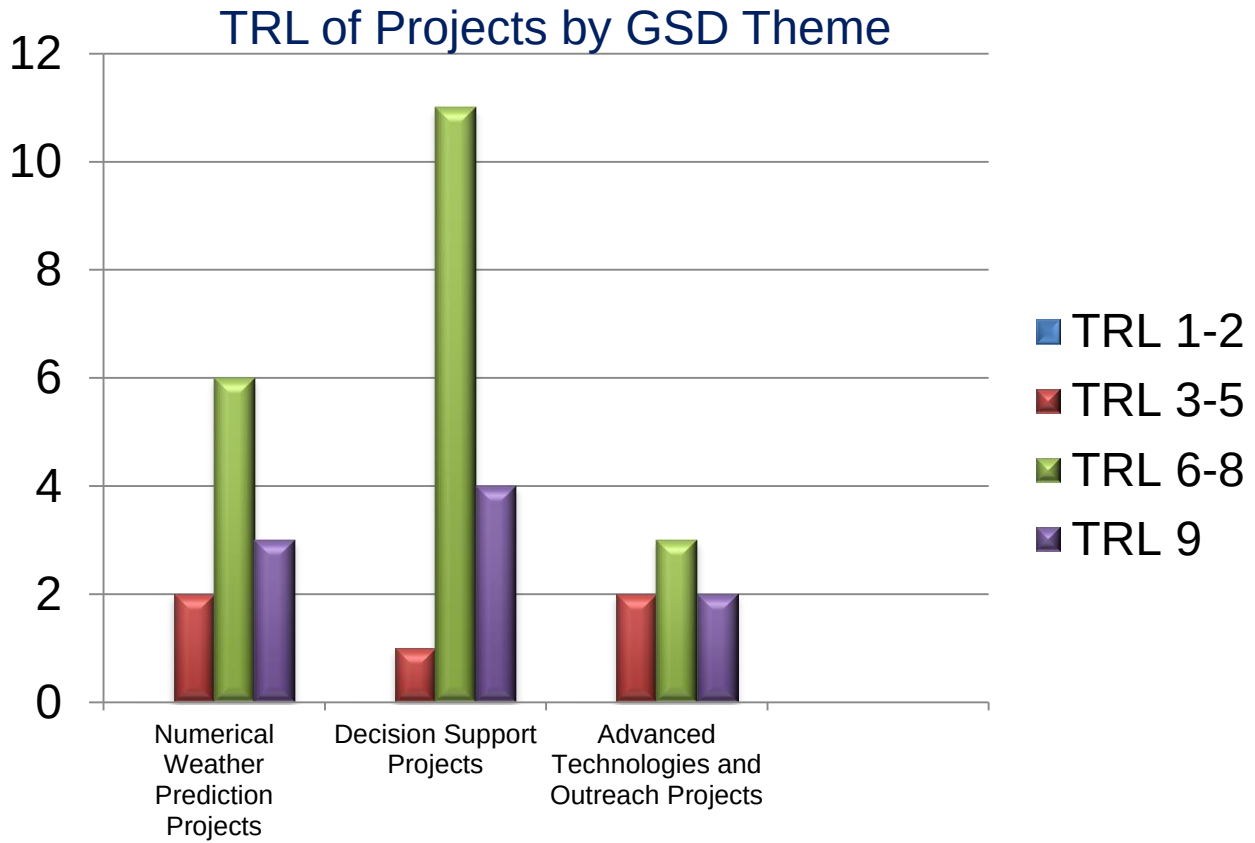
NOAA Research and Development Funnel

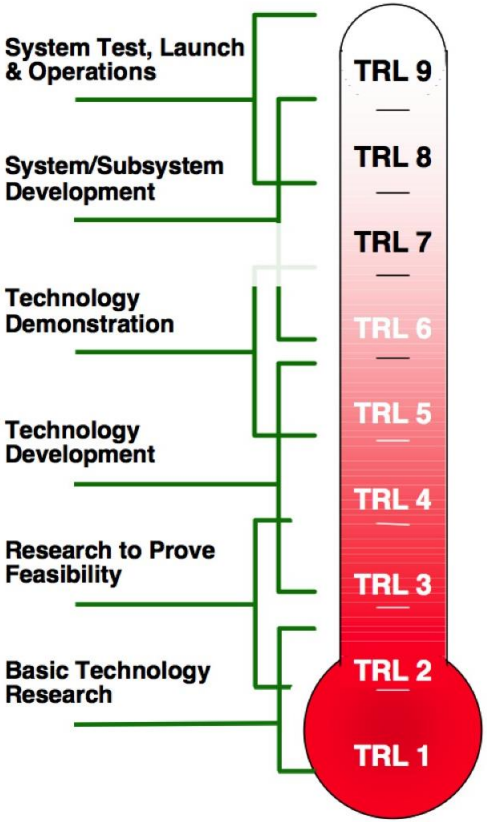


Income - FY15 (~$32M)



Performance: Portfolio Balance





Performance: Leadership

Project	GSD Leadership Role	Outcome
Developmental Testbed Center	Changes to HWRF model, NGGPS (planned)	HWRF – improve surface fluxes, cloud-radiation interactions
HIWPP – accelerate U.S. global models	Intercomparison of dynamic cores of global models	NWS down-selected two candidates for NGPPS
Frequently-updated, short-range, high resolution model development	RUC, RAP, HRRR, and FIM development	Improved storm-scale forecast skill
Observing System Experiments/OSSE	R2O data assimilation of GNSS-RO and ground-based GPS; SHOUT (Global Hawk UAS instruments)	Adding RO satellites will improve weather forecast skill; Currently evaluating impact of GPS Radio Occultation and UAS data
Assessments of R2O Aviation Products	Aviation products readiness for operations	Eight of 19 weather products evaluated have transitioned to operations
High Performance Computing Techniques	Fine grain computing; Unified coding models to run on GPUs, MICs and CPUs	FORTRAN to CUDA compiler prototype for GPU and MIC manufacturers
Renewable Energy	Wind Forecast Improvement Projects 1 and 2 and Solar Forecast Improvement Project to improve skill of RAP and HRRR.	Optimizing wind and solar energy production

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Assessments of R2O Aviation Products	[-]liness for operations	Eight of 19 weather products evaluated have [-]
High Performance C[-] Techniques		r prototype for [-]s
Renewable Energy		[-]ergy production

"High Impact Weather Prediction Program (HIWPP)"

Led by GSD, HIWPP, *for the first time*, it brought together Modeling Centers across US & ***Accelerated*** NGGPS and model improvements by 2 years…

Performance: Innovation

Research and development that supports applications

Project	Why	How It Is Used	Results
Massively Parallel Fine Grain (MPFG) Computing	To run high resolution global forecast models at an affordable cost	Prototyped a compiler and coded experimental models to use GPUs & MICs for HPC computing	Manufacturers in the supercomputing industry are working on MPFG computing for weather forecasting models
TerraViz	Improved visualizations of data for research and education	TerraViz is leveraged by SOS Explorer and NEIS	Thousands of SOSx downloads in more than 50 countries
NEIS (NOAA Environmental Information System)	Big data will require a capability to mine, collect, consolidate, visualize, and interact with disparate data across NOAA using the Internet	Used as a platform to access and evaluate next-generation global forecast models	Experimental model data can now be compared over the Internet without the need for access to super computers
Central Weather Bureau Taiwan	Leverage funds and talent for mutually beneficial projects	Share scientific talent and knowledge	New/improved severe weather forecast tools

Performance: Innovation

Research and development that supports applications

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NEIS (NOAA Environmental Information System)	Big data w... ...bility to mine, collect, co... and i... NOA...	Used as a platform to access and evaluate next-generation	Experimental model data can now be compared over the Internet ...to
Central Weather Bureau Taiwan	Lever... bene...		...ner

TerraViz and NEIS allow seemless data integration and interaction across 4D time and space for NOAA

Performance: Strategic Agreements

- NWS Next Generation Global Prediction System
  - GSD leading 5 Year MOU for OAR to work on NGGPS (*in review)*

- NESDIS-NWS-GSD - 5 Year MOU for COSMIC-2 and GPS-RO

- Intellectual Property
  - Agreement with CIRES provides IP protection through Copyright
  - Incentives for licensing IP & royalty payments
  - Reinvestment of funds supporting R&D

Performance: Strategic Direction

GSD's Grand Challenges

1. Develop a continuous global to storm-scale (≤3km) ensemble data assimilation and ensemble forecasting capability for global situational awareness

2. Create a fully coupled NOAA Earth System Analysis & Prediction capability

3. Provide the most accurate environmental information, including uncertainty and probabilities, to the right people at the right time, and in the right form for optimal understanding and decision-making.

4. Determine the best, most cost effective environmental observing systems needed to improve earth system predictions

5. Create easily accessible systems to offer instant insights into the meaning of information and data

Relevance to NOAA's Mission

NOAA Weather Ready Nation Goal:
Reduced loss of life, property, and disruption from high-impact events

GC1: Global to storm-scale forecasts

NOAA Science and Technology Enterprise:
An integrated environmental modeling system

GC2: Fully coupled Earth system modeling and prediction

NOAA Weather Ready Nation Goal:
A more productive and efficient economy through environmental information relevant to key sectors of the U.S.

GC3: Provide accurate, relevant, and timely environmental information

NOAA Science and Technology Enterprise: Accurate and reliable data from sustained and integrated Earth observing systems

GC4: Determine the best environmental observing systems

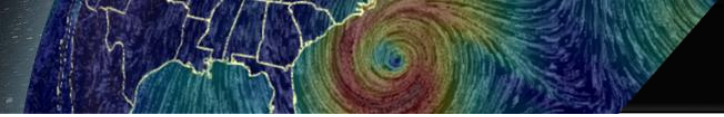
NOAA Engagement Enterprise
An engaged and educated public with an improved capacity to make scientifically informed environmental decisions

GC5: Instant insights into data meaning

GSD Grand Challenges Relevant to NOAA's Next Generation Strategic Plan

Examples: Paths to the Future

2005	2015	2020-2030
Advanced Computing MPP	MPFG (Massively Parallel Fine Grain) R&D for NWP	MPFG HPC Standard for Next Generation Forecast Models
Surface Observation Network	Building Initial OSE/OSSE Capability	Fast, Flexible OSE/OSSE
CONUS Mesoscale Atmospheric Modeling	Global Hydrostatic & Non-hydrostatic Models, Warn-On-Forecast	Global Non-hydro, High-resolution Models ≤ 3km (w/NWS/NGGPS)
Information Systems (AWIPS)	AWIPS-2, NEIS, Coupled Atmospheric-Chemistry Models	Forecast Office of the Future: FACETs & NOAA Earth System Analyzer/Predictor (NESAP)



GSD Strategic Plan

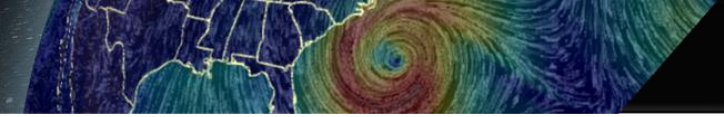
Vision

"Making Forecasts Better!"

GSD Strategic Plan

Draft GSD plan is available for comment at:

(http://esrl.noaa.gov/gsd)



Outline for Next 2 Days

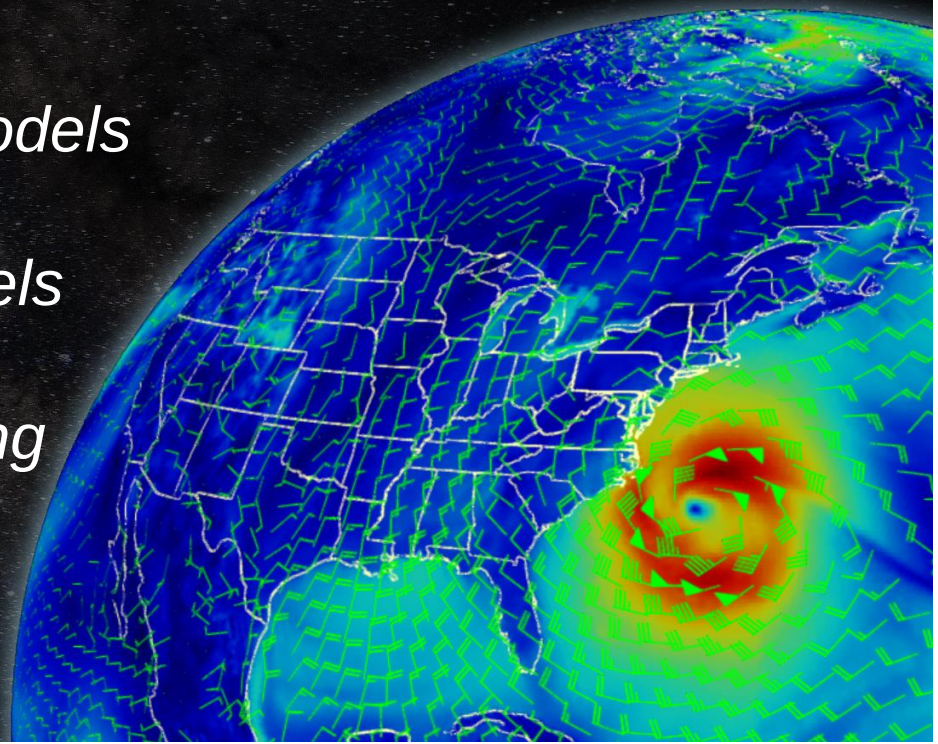
Review Research Areas

Theme 1: Numerical Weather Prediction

Session 1: *Regional Models*

Session 2: *Global Models*

Session 3: *Cross-Cutting Activities*

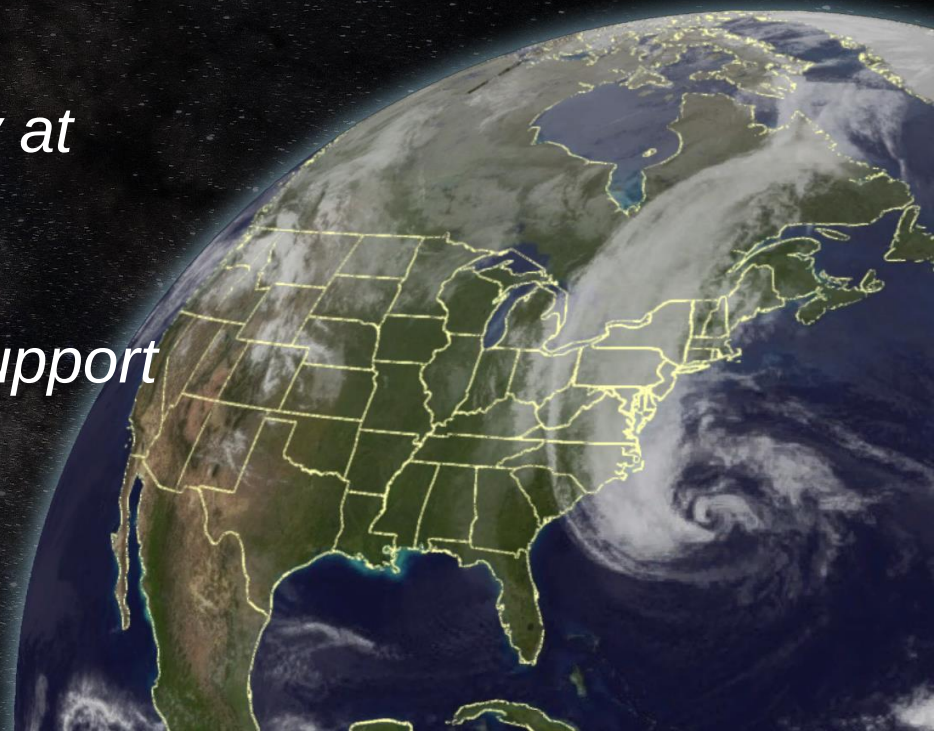


Review Research Areas

Theme 2: Decision Support

Session 4: *A Busy Day at Forecast Offices*

Session 5: *Decision Support for Aviation*

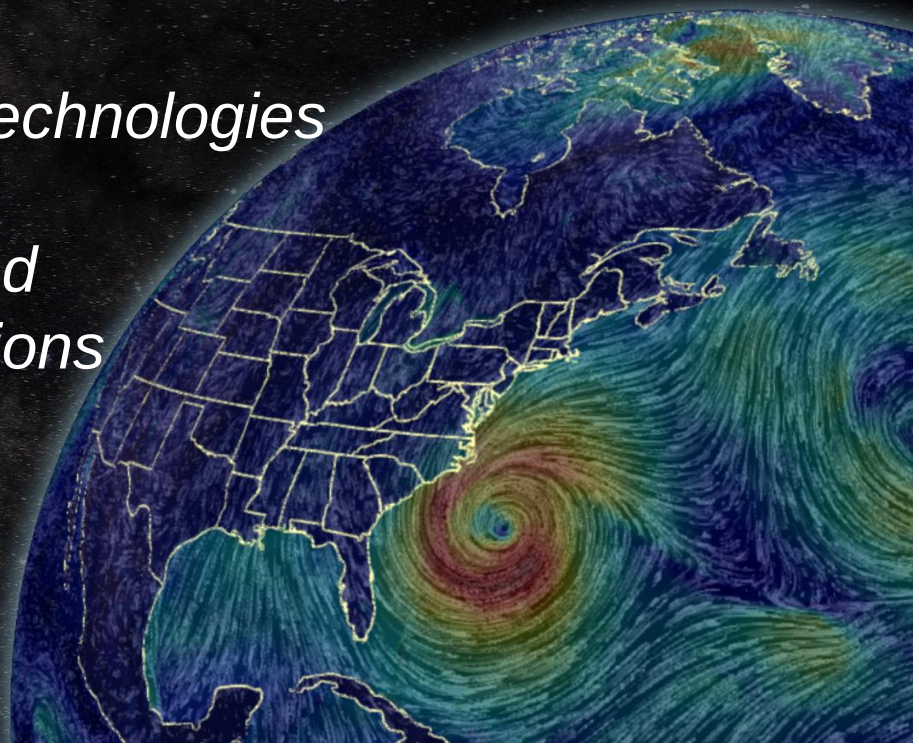


Review Research Areas

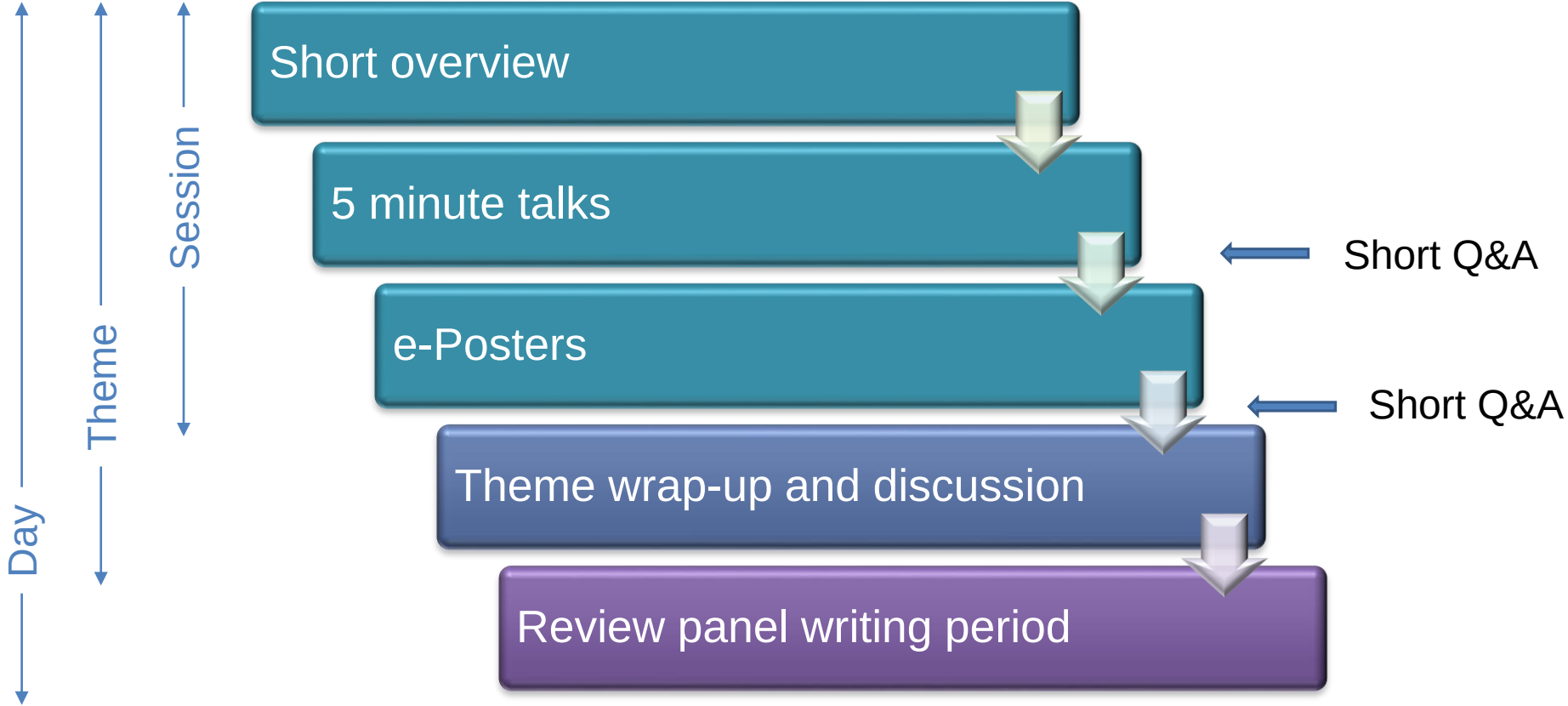
Theme 3: Advanced Technologies

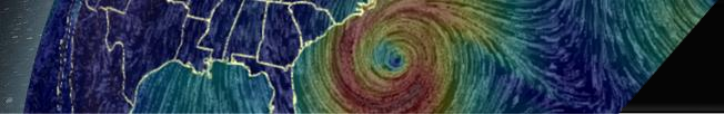
Session 6: *Advanced Technologies*

Session 7: *Outreach and Research to Operations*



Format for the Review





Discussion